



ODISHA POWER TRANSMISSION CORPORATION LIMITED

**TECHNICAL SPECIFICATION
FOR**

**400KV/220KV/132KV
PORCELAIN/ POLYMER HOUSING CAPACITIVE VOLTAGE
TRANSFORMER**

IMPORTANT INSTRUCTION:

Please read the following instructions carefully before submitting your bid:

- 1.1** All the drawings, i.e. dimension, elevation, side view, front view, plan, cross sectional view, isometric view, important component drawing etc., in PDF along with AutoCAD format and manuals(Technical/Installation/Operation) in PDF format, for offered item shall be submitted. The hard copies as per specification also shall be submitted.
- 1.2** The acceptability of Type Test reports submitted by any bidder/EPC shall be strictly in adherence to the broad guidelines mentioned in clause no. 2 of “CEA guidelines for the validity period of Type Tests conducted on major electrical equipment of power transmission system” published in May 2020.
- 1.3** The Bidder/EPC shall have to submit all the required type test reports for the offered item along with the accessories. In case of submission of soft copy of type test report, high resolution colour scan of the original test report must be submitted. Scanned copy of Xerox of type test reports shall not be entertained. If required, the firm has to show the original type test report for the purpose of verification. In absence of this, the evaluation shall be carried out accordingly as non-submission of type test reports. The type test report of Capacitive voltage Transformer submitted by the manufacturer shall be considered valid if the date of type test does not exceed 10 years as on the last date of submission of bid; provided:-
There is no major changes introduced in the basic design/technology/material/mechanical/construction/functionalities/performance characteristics/manufacturing process of the equipment.
OR
Until the relevant IS/IEC / statutory guidelines is revised which warrants fresh type tests because of introduction of new type tests even though there is no change in material/basic design of the equipment.
- 1.4** The Bidder/EPC must fill up all the point of GTP for offered item/s. Instead of indicating “refer drawing, or as per IS/IEC”, the exact value/s must be filled in. All the points other than GTP, which are asked to confirm in technical specifications must be submitted separately with the bid.
- 1.5** The Bidder/EPC is required to impart training in view of manufacture, assembly, erection, operation and maintenance for offered item, at his works, to the person/s identified by OPTCL, in the event of an order, free of cost. The cost of logistics will be borne as per the clauses of respective purchase orders/work orders.
- 1.6** The discrepancies between the specification and the catalogues or literature, submitted as part of the offer OR with prevalent standards/Govt. guidelines shall not be considered as valid deviations unless otherwise the same deviations related to TS is brought out separately by the Bidder/EPC in the pre-bid queries or in form of clarification. If any modification felt necessary to improve performance, efficiency and utility of equipment, the same must be submitted along with Pre-Bid Queries with reasons duly supported by documentary evidences and such modifications, not mentioned in Pre-bid queries, will not be considered.
- 1.7** For purpose of Agreement, the firm shall provide warranty as specified in the purchase order / tender document. Notwithstanding the foregoing, Supplier agrees to waive the expiration of the Warranty Period in the event where in a pattern of defect/trend of failure is observed after the Warranty Period in a significant portion of the supplied quantity, or any critical defect discovered which, in Purchaser's opinion, constitutes a threat of damage to property or to the health and safety of any person.
- 1.8** Warranty certificate for purchase of any material, whether directly procured by OPTCL or EPC agency, shall be issued directly in favour of OPTCL.

SCOPE:

- 2.1** This Specification provides for the design, manufacture, inspection and testing before dispatch, packing and delivery F.O.R. (destinations) of Capacitive voltage transformer and other accessories as specified here in.

Following is the list of documents constituting this Specification. :

(i)	Technical Specification (TS)	-
(ii)	Technical Requirements	Appendix-I
(iii)	Quantity and delivery schedule	Appendix-II
(iv)	Guaranteed Technical Particulars	Annexure-A
(v)	Calibration Status of testing equipment and meters/Instruments.	Annexure-B
(vi)	Check-list towards Type Test Reports.	Annexure-C
Note: Annexure-A, B & C are to be filled up by the Bidder/EPC.		

- 2.2** All the above along with amendments thereof shall be read and interpreted together. However, in case of a contradiction between the Technical Specification and any other volume, the provisions of this volume will prevail.
- 2.3** The Capacitive Voltage Transformer shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or materials, which in his judgment is not in full accordance therewith.

STANDARDS:

Except to the extent modified in the Specification, the Capacitive Voltage Transformer shall confirm to the latest editions and amendments of the standards listed hereunder.

STD	DESCRIPTION
IEC 61869-1/ IS 16227-1	<i>Instrument transformers —Part 1: General requirements</i>
IEC 61869-5/ IS 16227-5	<i>Instrument transformers —Part 5: Additional Requirements for Capacitive Voltage Transformers</i>
IS 335	<i>New insulating oil</i>
IS 613	<i>Copper rods and bars for electrical purposes</i>
IS 2071-1	<i>Methods of high voltage testing</i>
IS/IEC 60060	<i>High-Voltage Test Techniques</i>
IS/IEC 60137	<i>Bushings for alternating voltages above 1 000 Volts</i>
IS/IEC 60947	<i>Low-voltage switchgear and control gear</i>
IEC 60529	<i>Degrees of protection provided by enclosures (IP) code</i>
IS/IEC 60071	<i>Insulation coordination</i>
IS:3347	<i>Dimensions of Porcelain Transformer Bushing</i>
IS 9676	<i>Reference ambient temperature for electrical equipment</i>
IS/IEC TR 62271-301	<i>High-voltage switchgear and control gear – Part 301: Dimensional standardization of high-voltage terminals</i>
IEC 60567	<i>Oil-filled electrical equipment – Sampling of gases and of oil for analysis of free and dissolved gases – Guidance</i>
IEC TS 60815	<i>Selection and dimensioning of high-voltage insulators intended for use in polluted conditions</i>
IEC 62155	<i>Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V</i>
IEC 61462	<i>Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V –</i>

	<i>Definitions, test methods and acceptance criteria and design recommendations</i>
IEC 62217	<i>Polymeric HV insulators for indoor and outdoor use - General definitions, test methods and acceptance criteria</i>
IS 2629	<i>Recommended Practice for Hot-Dip Galvanizing of Iron and Steel</i>
IS-5547	<i>Application guide for Capacitor Voltage Transformers</i>
IS-9348	<i>Coupling Capacitor & Capacitor Devices.</i>

Note:

Capacitive Voltage Transformer with the requirement of other authoritative standards, which ensure equal or better quality than the standards, mentioned above shall also be acceptable. Where the equipment offered by the supplier confirms to other standards, salient points of difference between the standards adopted and the specified standards shall be clearly brought out in the offer. 4 (Four) copies of the reference standards in English language shall be furnished along with the offer.

TOPOGRAPHICAL AND METROLOGICAL CONDITIONS:

Location	State of Odisha
Altitude	1000 m
Air Temperature	
Minimum	0 °C
Maximum	50 °C
Maximum Daily Average	35 °C
Maximum Humidity	99 %
Pollution Level	Heavy/Very Heavy
Airborne Contamination	Highly Polluted
Isoceraunic Level	70 day/annum
Average no. of dust storm days per annum	20 day/annum
Seismic withstand level	0.3 g (Horizontal) & 0.15g (Vertical)
Wind velocity	55 m/s (Wind zone VI)
Average Annual Rain Fall	150 cm
Average no. of rainy days in a year	120 days
Special Environmental Conditions	<ol style="list-style-type: none"> 1. In coastal areas of the state presence of salinity in air and exposure to moisture 2. In industrial belts of the state excessive dust in air

GENERAL AND TECHNICAL REQUIREMENTS:

- 5.1 The CVT shall be of outdoor, oil impregnated paper insulated, single phase, 50 Hz, oil immersed, self- cooled and suitable for the services indicated and for operation in the climatic conditions specified without protection from sun, rain and dust. The CVT shall be complete in all respects and shall conform to the modern practice of design and manufacture.
- 5.2 The CVT shall be suitable for transport in horizontal position, if the transport limitation so demand.
- 5.3 The design of capacitor voltage transformers shall be such that its accuracy shall not be affected by the presence of pollution on the external surface of its insulators.

Note: The rated frequency at which the CVT shall meet its accuracy requirement for both metering and protection windings: Sub-Clause 5.4 of IEC 61869-5 is applicable with the following additions for meeting the accuracy requirement:

- a. For Measuring Accuracy Class the rated frequency range is from 99% to 101% of rated frequency.
- b. For Protective Accuracy Class the rated frequency range is from 96% to 102% of rated frequency.

5.4 The CVT shall operate satisfactorily in system with high X/R ratio. ($T_p=100$ ms).

5.5 The EMU tank of the offered CVTs shall be of Cast Aluminium Alloy. Synthetic/Mineral Oil should be used in the EMU Tank. The other part of the CVT shall also be of Aluminium Alloy except the insulator.

5.6 Impregnation details along with tests and checks to ensure successful completion of impregnation cycle shall be furnished for purchaser's approval.

5.7 The CVT shall be capacitor voltage type with electromagnetic units and shall be suitable for carrier coupling.

5.8 All windings of Capacitive voltage transformer secondary shall be protected by MCB's of required rating. In addition, fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the CVTs shall be terminated to stud type non-disconnecting terminal blocks in the individual phase secondary boxes via.

5.9 CVTs shall be suitable for high frequency (HF) coupling, required for power line carrier communication. The carrier signal must be prevented from flowing into potential transformer (EMU) circuit by means of a RF choke/reactor, suitable for effectively blocking the carrier signal over the entire carrier frequency range i.e. 40 to 500 KHz. Details of the arrangement shall be furnished along with the bid. HF terminal of the CVT shall be brought out through a suitable bushing and shall be easily accessible for connection to the coupling devices of the carrier communication equipment, when utilized. The bushing shall be fully protected against rain and vermin so as to avoid the possibility of short circuits to earth. An earthing link with fastener shall be provided for HF terminal.

5.10 The electromagnetic unit, comprising compensating reactor, intermediate transformer and protective and damping devices should have a separate terminal box with all secondary terminals, brought out.

5.11 Voltage transformers should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.

5.12 The accuracy of the windings shall be maintained throughout the entire burden range preferably in the frequency range of 48 HZ to 51.5 HZ on all the three windings without any adjustment during operation.

5.13 The CVT assembly and other critical process shall be done in a dust free controlled environment, under positive pressure.

5.14 Polarity shall be indelibly marked on each primary and secondary terminal.

CONSTRUCTIONAL DETAILS:

- 6.1. The 400 KV, 220KV & 132KV CVT shall be suitable for mounting on support structure of tubular GI pipe or lattice type structures.
- 6.2. **The CVT's shall consist of two primary assemblies; the high voltage capacitor sections and the base box, housing the electro-magnetic components. Series connected capacitor elements, housed in porcelain insulators, each hermetically sealed, are referred to as capacitor sections. The dielectric of the capacitor elements shall be made up of high quality polypropylene film/paper and impregnated with highly processed synthetic fluid. A tap voltage (approximately 5-12 kV depending on type) is taken from the lowest capacitor section and fed to an electromagnetic circuit in the cast aluminum base box. The base box contains the intermediate transformer which will provide the final output voltages via multiple tapped secondary windings, series compensating reactor and Ferro resonance control circuitry. The base box shall be filled with dried mineral oil/synthetic oil, protecting the components from environmental deterioration. The Ferro resonance suppression circuit should not adversely affect transient response.**
- 6.3. Access to secondary terminals shall be possible without any danger of access to high voltage circuit.
- 6.4. CVTs shall be hermetically sealed units.
- 6.5. A protective surge Arrester/spark gap shall be provided to prevent break down of insulation by incoming surges and to limit abnormal rise of terminal voltage of shunt capacitor/primary winding, tuning reactor/RF choke etc. due to short circuit in transformer secondaries. In case of an alternative arrangement, the Bidder shall bring out the details in the Bid.
- 6.6. To prevent ferro resonance, suitable damping devices shall provided for connection to the transformer secondaries.
- 6.7. The creepage and flashover distances of the high capacitive voltage insulator shall be suitable for the outdoor service conditions, specified in the schedules.
- 6.8. The bidder in the offer is to state the suitable precautions/methods, adopted during design stage of the CVT to avoid the un-desirable effects due to ferro resonance phenomena. The precautions/methods include lower level of working flux density in EMU, greater utilization of the linear portion of the magnetization curve, providing an air gap in the magnetic circuit, connecting a suitable damping resistance permanently across the secondary etc.
- 6.9. It should be stated in the bid offer regarding the steps taken in the design stage for elimination/minimization of the influence of the transient response on the behaviour of high speed relays.
- 6.10. It shall be ensured by the bidder in the offer that the connection of carrier, frequency coupling device across the CVT will not affect the designated accuracy class of the CVT windings.
- 6.11. The capacitor divider unit shall comply to IS: 9348/1979.
- 6.12. It shall also be complied in the offer through a calculation sheet, proving that the designated accuracy class of the CVT (both metering and protection) are not affected by extreme temperatures, to be encountered in service conditions (Max. ambient temperature 50° C and minimum -0° C).
- 6.13. Separate point should be provided for measurement of capacitance & dielectric dissipation factor.

6.14. INSULATION:

6.14.1 The paper insulation shall be made up of high-quality, **high density paper with cellulose content of more than 75% complying with IEC 60554-2 and 60641-3-1.** The manufacturer shall submit the test certificate regarding conductivity and other major attributes like density, grammage, tan delta, dielectric strength, air permeability, capillary rise in distilled water etc. of paper insulation and the invoice of the above material to OPTCL representative during FAT. **Winding enamel coating shall comply with IEC 60317-0-1.** The necessary raw material test certificate shall be verified at the time of acceptance test by OPTCL representative.

6.14.2 CVT shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges. Provision shall be made on a screw cap for solid and secured earthing of the test tap connection, when not in use. A suitable caution plate shall be provided duly fixed on the cover of the secondary terminal box indicating the purpose of the test tap and the necessity of its solid earthing as per prescribed method before energizing the Capacitive Voltage Transformer.

6.15 EMU WINDING:

Suitably insulated copper wire of electrolytic grade shall be used for windings. The secondary conductor shall be of adequate cross section so that the maximum permissible current density shall not be exceeded even during short- circuit conditions. Windings shall be used for metering, relaying and synchronizing. Each winding shall comply requirements of both Part-I and V of up-to-date editions of IS-16227/IEC-61869.

6.16 TANK:

6.16.1 Tanks of the CVT shall be made of high quality Cast Aluminum Alloy and shall be able to withstand full vacuum and pressure, occurring during transit and thermal and mechanical stresses resulting from maximum short circuit current during operation. Other ferrous parts shall be hot- dip galvanized as per relevant standard.

6.16.2 The metal tanks (in case of Aluminium Alloy casting) shall have no welded joints so as to minimize possible locations of oil leakage.

6.16.3 Type tested CVT should have same construction and material of tank as the proposed Design. Other materials not acceptable.

6.16.4 Size of the terminal studs in offered CVTs must not be less than the type tested design.

6.17 HOUSING(As per tender conditions/Clause):

6.17.1 PORCELAIN:

a. The housing shall be made up of homogeneous, vitreous porcelain of high mechanical and dielectric strength; Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface, arranged to shed away rain water or condensed water particles (fog). The details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer.

b. The type and profile of the porcelain insulator sheds shall be in accordance with IEC 60815 & IEC 62155.

c. The specific creepage distance of insulators shall be 31mm/kV.

d. The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.

- e. The porcelains used shall be free from cavities and other flaws. The bushings shall have ample insulation, mechanical strength and rigidity for the condition under which they shall be used and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove the internal heat.
- f. Cast metal end caps for the bushings shall be of high strength, hot dip galvanized malleable iron. They shall have smooth surface to prevent discharge-taking place between the metal parts and porcelain as a result of ionization.
- g. The insulation of bushings shall be coordinated with that of the capacitive voltage transformer such that the flashover, if any, will occur only external to the capacitive voltage Transformer. The puncture strength of the bushings shall be greater than the flashover value.
- h. End shields should be provided for distribution of stresses, where required.
- i. Corona shields, if required should be provided.

6.17.2 POLYMER COMPOSITE: (only applicable when explicitly mentioned in the PO)

- a. Polymer housing material shall be made of high quality hydrophobic silicone rubber. Polymer Rubber housing shall be free from lamination cavities, surface tack, roughness or other flaws affecting the maximum level of mechanical and electrical strengths. Properties of the polymeric materials shall be specified in the offer and test reports for the same from a NABL accredited laboratory shall be submitted for approval of the purchaser. The polymer material which is used for arrester housing must be resistant to tracking & erosion, stabilized against UV radiation and shall not exhibit any fatigue to temperature and load.
- b. The CVT housing in general shall conform to IEC 61462 and IEC 62217 as applicable. It shall not fail due to housing contamination. Housing shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage up to maximum design value of CVT.
- c. The rain sheds / petticoats shall be of silicone polymer material and shall conform relevant standards.
- d. Type test reports of composite housing shall be submitted.
- e. The Polymer weather shed design shall be preferably of self-cleaning type (Aero foil design). The details of the Polymer housing shed profile such as distance, angle of Inclination, gap between the shed, diameter (ID and OD) etc. shall be as per relevant Standard and shall be indicated by the Bidder/EPC in his offer in the form, during detailed Drawing evaluation.
- f. **The minimum specific creepage distance of the Composite housing shall be 31 mm/kV.**

6.18 INSULATING OIL:

Insulating oil can be synthetic type or mineral oil type. The CVT capacitor section and EMU should contain same type of oil as the type tested CVT. RM test certificates shall be checked by OPTCL inspector during FAT.

The quantity of insulating oil for the filling and the complete specification of the insulating oil shall be stated. The mineral oil shall comply in all respects with the provisions of latest edition of IS: 335/IEC 60296. The capacitive voltage Transformers shall be supplied, filled with purified oil completely. **The tan delta**

value of insulating mineral oil should be ≤ 0.002 and water content less than 10 ppm.

6.19 PREVENTION OF OIL LEAKAGE AND ENTRY OF MOISTURE:

6.19.1 The supplier shall ensure that the sealing of the Capacitive Voltage Transformer is properly achieved. In this connection, the arrangement provided by the supplier at various locations shall be described and supported by sectional drawings.

6.19.2 Nuts and bolts or screws, used for fixation of the interfacing porcelain bushings for taking out terminals shall be provided on flanges, cemented to the bushings and not on the porcelain.

6.19.3 All sealing surfaces shall be smooth, straight, and reinforced, if necessary to minimize distortion and to make a tight seal. Sealing shall be done with O—ring seals. The O ring sealing shall have compression set of $< 15\%$ in adherence to ASTM D395-16. O rings shall be housed in CNC machined grooves. For gasketed joints, wherever used, nitrite butyl rubber gaskets or better quality of material shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

6.20 SECONDARY TERMINAL BOX:

6.20.1 The secondary terminals shall be brought out in a weather proof terminal box with a rating not less than IP-55. The secondary terminal box shall be made up of Aluminium Alloy of 3 mm thickness or stainless steel of 2mm thickness. The gland plates shall be either 3 mm thick Aluminium alloy or Stainless steel. The exterior of this terminal box shall be painted with minimum thickness 80 microns and above in case it is made up of Aluminium alloy.

6.20.2 All secondary terminals shall be brought out in a compartment on one side of each IVT for easy access.

6.20.3 The terminal box shall be provided with removable gland plate and glands suitable for 1100 volts grade. PVC insulated, PVC sheathed multi core 4 sq.mm to 6 sq.mm stranded copper conductor cable.

6.20.4 The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing/locking arrangement and shall be suitable to prevent penetration of moisture and rain water.

6.20.5 The dimensions of the terminal box and its openings shall be adequate to enable easy access and sufficient working space for use of normal tools.

6.20.6 The terminal blocks shall be 1.1. KV melamine material standard disconnecting type and provided with ferrules indelibly marked or numbered and their identifications shall correspond to the designation on the relevant wiring diagram.

6.20.7 MCBs of suitable size and rating shall be provided in the secondary box for protection gradation and isolation of the IVT secondary circuit.

6.20.8 Secondary wiring terminal studs shall be provided with at least three nuts, plain and spring washers. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum diameter of the studs shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads.

6.21 FITTINGS AND ACCESSORIES: Fittings and accessories, listed below shall be supplied with each CVT as applicable. Any fitting, required essential other than those listed below shall also be supplied along with each CVT.

6.21.1 OIL LEVEL INDICATOR: Oil level indicator shall be provided to indicate the oil level in the EMU.

6.21.2 OIL SAMPLING VALVE: All CVTs shall be provided with oil filling/draining valves for filling and collection of oil. Cover/Cap shall be provided. CVTs must have adequate provision for taking samples without exposure to atmosphere.

6.21.3 EARTHING: Metal tank of each CVT shall be provided with two separate earthing pad for bolted connection to 50mm X 6mm flat, to be provided by the purchaser for connection to station earth-mat. Nut and bolts for connection of grounding flat with grounding terminal shall be in the OEM's scope of supply.

6.21.4 LIFTING ARRANGEMENT: The capacitive Voltage Transformer shall be provided with suitable lifting arrangement to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing. Lifting arrangement (lifting eye) shall be positioned in such a way so as to avoid any damage to the porcelain/polymer housing or the tanks during lifting for installation / transport. Necessary string guides shall be offered which shall be of removable type.

6.21.5 RATING/NAME PLATE & MARKING:

- a. The CVT shall be provided with non-corrosive (stainless steel), legible name plate with the information specified in relevant standards, duly engraved on it.
- b. A schematic drawing indicating the connections shall be provided in the interior of the Secondary Terminal box.

6.21.6 TERMINAL CONNECTORS: Not in the scope of IVT supplier.

6.21.7 NUT & BOLTS:

- a. Nuts and bolts for mounting CT on CT structure shall be supplied by the OEM.
- b. Nut and bolts for connection of earthing flat with CT earthing terminal shall be supplied by OEM.

TESTS:

7.1. Type Tests:

7.1.1 All the equipment offered shall be fully type tested as per the relevant standards (IEC 61869-1/IS 16227-1 & IEC 61869-5/IS 16227-5 with latest amendments) & tests as indicated below. The bids offering equipment not type tested will be rejected. In case, the equipment of the type & design offered has already been type tested, the bidder/EPC agency shall furnish four sets of the type test reports along with the offer. The test must have been conducted not later than Ten years from the date of opening of the bids.

7.1.2 The purchaser reserves the right to demand repetition of some or all the type & additional type tests in the presence of its representative. For this purpose, the bidder/ EPC agency may quote unit rates for carrying out such type tests.

7.1.3 For any change in the design/type of already type tested CVT offered against this specification, the purchaser reserves the right to demand repetition of some or all type and special tests in presence of OPTCL's representative(s) at the cost of the supplier (without any extra cost to the purchaser) or reject the bid without any intimation.

7.1.4 All type test reports should have been conducted in independent third-party NABL laboratories. The tests for which testing facility is not available in India, should have been conducted in a laboratory of foreign Country accredited by National Accreditation Body of that Country.

7.1.5 The type tests conducted in-house by manufacturers shall also be acceptable provided the lab is accredited by National Accreditation Body of the Country and the tests have been witnessed by a representative of NABL accredited laboratory/Government Power Utility.

7.1.6 List of Type Tests as per IS/IEC:

1. Temperature-rise test
2. Lightning impulse withstand voltage test on primary terminals
3. Switching impulse withstand test on primary terminals for 420 kV CVT
4. Chopped impulse test
5. Wet withstand voltage tests
 - I. PF wet withstand for 145 kV and 245 kV CVT
 - II. Switching wet withstand for 420 kV CVT
6. Tests for accuracy
 - i) Type tests for accuracy of measuring core
 - ii) Type Tests for accuracy of protective core
 - iii) Type tests for accuracy of measuring and protective cores
7. Enclosure tightness test at ambient temperature
8. Short-circuit withstand capability test
9. Ferro-resonance tests
10. Transient response test
11. EMC tests: Radio Interference voltage test for 145kV, 245 kV VT
12. IP 55 test on secondary terminal box
13. Type test for carrier frequency accessories
14. Measurement of capacitance and dielectric dissipation factor
15. Transmitted overvoltage test
16. Mechanical terminal load test
17. Determination of the temperature coefficient (TC)
18. Tightness design test of capacitor units
19. Corona extinction voltage test for 245 kV VT
20. Seismic withstand voltage test as per IEC/TR 62271-300

7.1.7 Additionally all the hollow insulators should be completely type tested as per relevant standards.

7.1.8 Sequence of tests shall be followed as per IEC 61869.

7.1.9 All the dielectric type tests shall be carried out on the same instrument transformer. After the capacitive voltage transformers have been subjected to the dielectric type tests they shall be subjected to all the routine tests.

7.1.10 All the type tests shall be carried out on a maximum of two specimens.

7.1.11 After the CVT has been subjected to the dielectric type tests detailed above, it shall be subjected to all routine tests detailed below.

7.2 ACCEPTANCE/ROUTINE TESTS:

7.2.1 All acceptance/routine tests as stipulated in IEC-61969-1/5 and its latest amendments & routine tests as indicated below shall be carried out by the supplier in the presence of purchaser's representative.

7.2.2 As the use of Instrument Transformers are associated with tariff and billing, the manufacturer should have in house NABL accredited lab for conducting below mentioned acceptance tests. If the in house lab is not NABL accredited, than all FAT shall be done in third party NABL labs in presence of OPTCL representative, without any additional financial implication to OPTCL.

7.2.3 No sampling is allowed for factory acceptance tests. FAT of 100% of the offered quantity shall be witnessed by OPTCL representative.

7.2.4 List of Acceptance/Routine Tests:

- a. Appearance and Dimensional Check.
- b. Power-frequency voltage withstand tests on primary terminals
- c. Power-frequency voltage withstand tests on secondary terminals
- d. Tests for accuracy

- i. Routine tests for accuracy of measuring core
- ii. Routine tests for accuracy of protective core

- e. Verification of terminal marking
- f. Partial discharge measurement

(NOTE: before test, minimum PD sensitivity of HV laboratory shall be demonstrated as 2.5 pC)

- g. Enclosure tightness test at ambient temperature
- h. Ferro-resonance check
- i. Routine tests for carrier frequency accessories

- j. Measurement of capacitance and Tan delta at 10 kV and $\frac{U_m}{\sqrt{3}}$ in all 145 kV and above CVTs

7.2.5 The below tests are required to be carried out at least in one CVT per LOT in the factory during Acceptance test. These tests will be conducted on one randomly selected unit among the lot offered for inspection and these test will be conducted after HV test only.

- a) Lightning impulse withstand test on the primary terminals.
- b) Temperature rise test.
- c) DGA before and after LI impulse withstand test.
- d) Properties of Insulating Oil (Reference standard IEC 60296/IS 335)
 - i. BDV

- ii. Tan delta
- iii. Water content
- iv. Specific resistance

7.2.6 In addition to the above tests the following checks shall be done by OPTCL inspector during factory visit.

Visual verification by the inspector whether the workshop/assembly line of factory are maintained under positive pressure or not where critical components and assemblies are carried out.

7.2.7 ADDITIONAL TESTS:

The purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier/laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this specification.

8. INSPECTION:

- 8.1 The purchaser shall have access at all times to the works and all other places of manufacture, where the capacitive voltage transformers are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacture of all the accessories and for conducting the necessary tests.
- 8.2 The supplier shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangement could be made for inspection.
- 8.3 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected, tested and dispatch clearance issued. However, the purchaser reserves the right to alter the dispatch schedule, attached to this specification without any extra financial liability to OPTCL.
- 8.4 The acceptance of any quantity of equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection, if such equipment are found to be defective.
- 8.5 Before offering for inspection, the supplier shall furnish shop routine test certificates and calibration reports of the equipment/instruments to be used during testing. After acceptance of these calibration reports and shop routine test certificate, inspecting officer will be deputed for witnessing such inspections.
- 8.6 The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought-out items.

9. QUALITY ASSURANCE PLAN:

- 9.1 The Successful Bidder/ EPC agency shall submit Quality Assurance Plan for manufacturing process for approval (or may comply to the Standard Manufacturing Quality Plan of OPTCL if available with the Technical specification).
- 9.2 The Successful Bidder/ EPC agency shall submit process flow chart for the manufacturing process along with the drawings/GTP.
- 9.3 The QAP shall contain the followings:
 - 9.3.1 RAW Materials/Bought out items:
 - 9.3.1.1 Incoming raw materials/bought out items from sub vendors,

- 9.3.1.2 Name of the sub vendors,
- 9.3.1.3 List of standards to which the raw materials/bought out items adhere/according to which the raw materials are manufactured,
- 9.3.1.4 List of tests carried out by the OEM on the raw materials/bought out items to verify the quality of the incoming raw materials with sampling rate of the tests,
- 9.3.1.5 Acceptance norms,
- 9.3.1.6 The record of these test results shall be kept for verification by OPTCL.
- 9.3.2 In process inspection by OEM:
 - 9.3.2.1 List of tests carried out by OEM to ensure quality at various stages of manufacture.
 - 9.3.2.2 Sampling rate of the tests
 - 9.3.2.3 Reference standards for tests and acceptance norms,
 - 9.3.2.4 The record of these test results shall be kept for verification by OPTCL.
 - 9.3.2.5 OPTCL preserves the right to witness all/some of these tests at the factory premises of OEM.**
- 9.3.3 Factory acceptance tests:
 - 9.3.3.1 All tests as per IEC 61869-1/61869-5 as applicable on CVT.
 - 9.3.3.2 Quantum of check/Sampling rate = 100%.
 - 9.3.3.3 Reference standards for tests and acceptance norms,
 - 9.3.3.4 Tests shall be carried out by manufacturer and witnessed by OPTCL representative.
- 9.3.4 Type test reports:
 - 9.3.4.1 The QAP shall also contain list of type test conducted on the design,
 - 9.3.4.2 Reference standard,
 - 9.3.4.3 Acceptance norms.
- 9.3.5 Level of automation achieved and list of areas where manual processing exists.
- 9.3.6 List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such test and inspections.
- 9.3.7 Special features provided in the equipment to make it maintenance free.
- 9.3.8 List of testing equipment available with the OEM for final testing of CVT vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. Any limitations in this regard shall be very clearly brought out in the offer.
- 9.3.9 All the testing equipment, meters etc, should have been calibrated in a NABL accredited laboratory. The Bidder must submit the list of testing equipment and meters test-wise as per Annexure – B of the Technical Specification.
- 9.3.10 Packing and Dispatch:
 - 9.3.10.1 List of checks to ensure the completeness of equipment and accessories as per PO,
 - 9.3.10.2 List of checks to ensure proper packing of CB and spares,
 - 9.3.10.3 Supply of O&M Manual and test reports.
- 9.4 Subsequent to/(During) approval of drawings/GTP & before offering inspection, the supplier shall, submit following information to the purchaser:
 - 9.4.1 List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

- 9.4.2 Type test certificates of the raw material and bought out accessories. **(Paper Insulation, Core, Winding , insulating oil, Terminal Clamps & Hollow Insulators)**
- 9.4.3 Quality assurance plan (QAP) withhold points for purchaser's inspection (if purchaser so desires). The QAP and hold points shall be discussed between the purchaser and the supplier before the QAP is finalized.
- 9.5 The supplier shall submit the raw material/ bought out item test certificates and routine test reports, before/at the time of offering inspection call.

10. DOCUMENTATION:

- 10.1 All dimensions in submitted drawings shall be in SI units.
- 10.2 All submitted drawings, GTP, MQP, and other documentations shall confirm to IS/IEC and this TS.
- 10.3 List of drawings & documents:
The Bidder/ EPC agency shall furnish four sets of the following drawings/documents along with the offer.
- 10.3.1.1 General outline drawings showing dimensions and shipping weights, quantity of oil etc.,
- 10.3.1.2 Sectional views showing
- 10.3.1.2.1 General constructional features,
- 10.3.1.2.2 Materials / gaskets / sealing used,
- 10.3.1.2.3 The insulation arrangement, method of connection of the primary / secondary winding to the primary / secondary terminals etc.
- 10.3.1.2.4 Circuit diagram of the CVT and EMU
- 10.3.1.3 Guaranteed technical Particulars,
- 10.3.1.4 Schematic drawing,
- 10.3.1.5 Rating and Diagram plate,
- 10.3.1.6 Secondary Terminal Box,
- 10.3.1.7 The detailed dimensional drawing of Porcelain Housing/Polymer housing such as ID, OD, thickness and Insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creep age distance etc.,
- 10.3.1.8 Assembly Sectional view of Primary Terminal,
- 10.3.1.9 Assembly drawing for secondary terminal,
- 10.3.1.10 Drawing showing details of Oil level Indicator and position of sampling valve
- 10.3.1.11 All type and special test reports relating to test
- 10.3.1.12 Ratio and phase angle error curves for CVTs,
- 10.4 After placement of order the supplier shall submit four sets of final version of all the above drawings/GTP for purchaser's approval. The purchaser shall communicate his comments/approval on the drawings to the supplier within reasonable period. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval. After receipt of purchaser's approval, the supplier shall, submit 15 prints of the approved drawings for purchaser's use.
- 10.5 The supplier shall also furnish fifteen (15) copies of manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and approved drawings pertaining to the CVTs. Marked erection drawings shall identify the component parts of the equipment as shipped to enable purchaser to carry out erection with his own personnel. Each manual shall also contain one set of

all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched. The instruction manuals shall contain storage, handling, erection, commissioning, troubleshooting, servicing and overhauling instructions.

10.6 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier's risk.

10.7 Approval of drawings/work by purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering design workmanship & latest revisions of relevant standards at the time of ordering & purchaser shall have the power to reject any work or materials which in his judgment is not in full accordance therewith.

10.8 TEST REPORTS:

10.8.1 Four copies of type test and special test reports shall be furnished to the purchaser with the tender offer.

10.8.2 Four copies of acceptance test reports shall be furnished to the purchaser as per the inspection of testing. One copy will be returned, duly certified by the purchaser and only there afterwards shall the material be dispatched.

10.8.3 All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.

10.8.4 All test reports of tests conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when requested for by the purchaser.

11. PACKAGING AND FORWARDING:

11.1 The equipment shall be packed in suitable crates so as to withstand handling during transit and outdoor storage. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing and handling. The easily damageable materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.

11.2 Each consignment shall be accompanied by a detailed packing list containing the following information:

11.2.1.1 Name of the consignee.

11.2.1.2 Details of consignment.

11.2.1.3 Destination.

11.2.1.4 Total weight of consignment.

11.2.1.5 Sign showing upper / lower side of the crate.

11.2.1.6 Handling and unpacking instructions.

11.2.1.7 Bill of material indicating contents of each package and spare material.

11.2.1.8 Manuals containing approved drawings & test reports

11.3 The supplier shall ensure that the packing list and bill of material are to be supplied in advance to the purchaser & to the consignees before dispatch.

12. COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in the specification but which are usual or necessary in the equipment of similar plant shall be deemed to be included in the contract and shall be supplied by the supplier without extra charges. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not. The detail bill of materials list to be furnished along with the tender.

APPENDIX – I. **(TECHNICAL REQUIREMENTS)**

SL. NO	PARTICULARS	132KV CVT	220KV CVT	400 KVCVT
1	Type	Single phase, 50Hz, oil Filled, self-cooled, Hermetically sealed, Outdoor porcelain type.	Single phase, 50Hz, oil Filled, self-cooled, Hermetically sealed, Outdoor porcelain type.	Single phase, 50Hz, oil Filled, self-cooled, Hermetically sealed, Outdoor porcelain type.
2	Nominal system voltage.	132KV	220KV	400 KV
3	Highest system voltage.	145KV	245KV	420 KV
4	Frequency.	50Hz \pm 5%	50Hz \pm 5%	50Hz \pm 5%
5	System earthing.	Effectively solidly earthed.	Effectively solidly earthed.	Effectively solidly earthed.
6	Number of phases.	3 [single phase]	3 [single phase]	3 [single phase]
7	(i)Number of secondary windings. (ii)Purpose of windings.	2 [two] Protection & metering.	3 [three] Protection & metering.	3 [three] Protection & metering.
8	Rated primary voltage.	132/ $\sqrt{3}$ KV	220/ $\sqrt{3}$ KV	400/ $\sqrt{3}$ KV

9	Rated secondary voltage.	Winding-I-110/V3V Winding-II-110/V3V	Winding-I-110/V3V Winding-II-110/V3V Winding-III-110/V3V	Winding-I-110/V3V Winding-II-110/V3V Winding-III-110/V3V
10	Ratio	132KV/V3: 110V/V3	KV,220KV/V3: 110V/V3	400/V3KV/110/V3 KV
11	Rated burden.	Winding-I (P)-50 VA Winding-II (M) - 50 VA/ 0.2 class simultaneous burden-100 VA with accu. cl-0.2	Winding-I (P)-50 VA Winding-II (P)-50 VA Winding-III(M)-50 VA/0.2 class simultaneous burden-150 VA with accu. cl-0.2	Winding-I (P)-50 VA Winding-II (P)-50 VA Winding-III(M)-50 VA/0.2 class simultaneous burden-150 VA with accu. cl-0.2
12	Accuracy class .	3P-T2/0.2	3P-T2/3P-T2/0.2	3P-T2/3P-T2/0.2
13	Rated voltage factor at rated frequency.	1.2 continuous. 1.5 for 30 second.	1.2 continuous. 1.5 for 30 second.	1.2 continuous. 1.5 for 30 second.
14	Temperature rise at 1.2 times the rated primary voltage, rated frequency & rated burdens.	As per IEC-61869.	As per IEC-61869.	As per IEC-61869.
15	Temperature rise at 1.5 times the rated primary voltage for 30 seconds, rated frequency & rated burden.	As per IEC-61869.	As per IEC-61869.	As per IEC-61869.
16	One-minute power frequency dry withstands test voltage for primary winding.	275KV [rms]	460 KV rms	630 KV [rms]
17	1-minute power frequency wet withstands test voltage for primary winding.	275KV [rms]	460 KV rms	630 KV [rms]
18	1.2/50 micro second impulse withstand test voltage for primary winding	650KV [peak]	1050KV [peak]	1425 KV peak
19	One-minute power frequency withstands test voltage for Secondary winding	3KV [rnms]	3KV [rnms]	3KV [rnms]
(i)				
(ii)	Between LV(HF) terminal & earth terminal	10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.	10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.	10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.

20	Class of insulation.	'A' or better for EMU.	'A' or better for EMU.	'A' or better for EMU.
21	Material of the conductor of primary and secondary windings.	Copper for EMU	Copper for EMU	Copper for EMU
22	Short Circuit Fault level of the bus to which the equipment will be connected.	40 KA [rms] 1 second.	50KA [rms] for 1 second	63 KA (rms) for 1 sec
23	Minimum creepage distance.	31mm/KV		
24	Quality of oil.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.
25	RIV at $1.1 \times \frac{U_m}{\sqrt{3}}$	$\leq 1000 \mu V$		
26	Acceptable Partial discharge level.	<p><i>At PD Test voltage U_m, PD level $\leq 10 pC$</i> <i>At PD Test voltage $1.2 \times \frac{U_m}{\sqrt{3}}$, PD level $\leq 5 pC$</i></p>		
27	Seismic acceleration- Horizontal – Vertical.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.
28	Accuracy class of standard V.T. to be used during testing towards determination of ratio errors and phase angle errors for metering windings.	0.05 or better.	0.05 or better.	0.05 or better.
29.	Capacitance (Pf)	8800 (+10% & -5%)	8800 (+10% & -5%)	8800 (+10% & -5%)

APPENDIX – II

QUANTITY AND DELIVERY SCHEDULE

Lot	Description.	Quantity required in No.s	Desired delivery.	Destination.
1	2	3	4	5
1	400 KV CVT		Within xxxxx months from the date of placement Purchase Order	Any store/site within Orissa State, same will be mentioned in the purchase order/release order.
2	220KV CVT		-do-	-do-
3	132KV CVT		-do-	-do-
	33KV CVT			

The detail delivery program and quantity to be delivered will be intimated at the time of placement of the purchase order/issue of release order.

ANNEXURE-A.
GUARANTEED TECHNICAL PARTICULARS FOR 420/245/145 KV CVT
(To be filled in by the Bidder/EPC)

Sl. No.	Description.	132 KV CVT	220 KV CVT	400 KV IVT
		3PT2/0.2 Accuracy Class	3PT2/3PT2/0. 2 Accuracy Class	3PT2/3PT2/0. 2 Accuracy Class
1	Bidder's name and address.			
2	Name and address of the Manufacturer.			
3	Manufacturer's type and designation.			
4	Standards applicable.			
5	Type of CVT			
6	Rated primary voltage (kV).			
7	Rated secondary voltage (volts).			
7.1	Winding-I.			
7.2	Winding-II.			
7.3	Winding-III.			
8	Rated frequency [HZ].			
9	Burden:-			
9.1	Rated burden			
	a) Protection Winding			
	b) Protection Winding			
	c) Metering Winding			
9.2	Simultaneous Burden			
9.3	Thermal burden			
10	Number of secondary windings.			
11	Accuracy class.			
11.1	[protection] Winding			

11.2	[metering] Winding			
12	Rated voltage factor for continuous operation at rated frequency.			
13	Rated voltage factor for 30 seconds at rated frequency.			
14	1.2/50/micro second Impulse withstand test voltage of capacitor (KVP).			
15	250/2500 micro second switching surge withstand voltage of capacitor (dry & wet).			
16	One minute power frequency test voltage of capacitor (dry & wet) (KV).			
17	One minute power frequency test voltage of H.F. terminal (KV).			
18	One minute power frequency test voltage of secondary winding (KV).			
19	Temperature rise over an ambient temperature of 50°C			
19.1	With 1.2 times rated primary voltage at rated frequency and at rated burdens. [I] Winding [°C] [II] Oil [°C] [III] Other parts [°C]			
19.2	With 1.5 times rated primary voltage for 30 seconds at rated frequency and at rated burdens. [I] Winding [°C] [II] Oil [°C] [III] Other parts [°C]			
20	Class of insulation.			
21	Total creepage distance in (mm)			
22	Maximum radio interference voltage at 1.1 times maximum line to ground voltage (micro volts)			
23	Corona inception and extinction voltage (kv) rms			
24	Partial discharge level (picocoulombs)			
25	ELECTROMAGNETIC UNIT:-			
25.1	CORE:-			
	a) Core diameter (mm)			
	b) Window Weight (mm)			
	c) Leg centre (mm)			
	d) Net cross sectional area of iron In the core (mm ²)			
	e) Core lamination thickness (mm)			
	f) Type & grade of core.			
	g) Design flux density at rated voltage. and rated frequency (Tesla)			

	h) Design flux density at highest system Voltage & lowest system frequency (Tesla).			
	i) Minimum knee point voltage (volts).			
25.2	<u>PRIMARY WINDING:-</u>			
	a) No. of turns.			
	b) Bare size of conductor			
	c) Insulated size of conductor.			
	d) Area of cross section.			
	e) Current density (A/ mm ²).			
	f) Conductor material.			
	g) Class of insulation.			
	h) Power frequency withstand level. (KV-rms).			
	i) Impulse withstand level (KVP).			
25.3	<u>Secondary Winding.</u>			
	a) No.of turns			
	b) Bare conductor size (mm)			
	c) Insulated conductor size (mm)			
	d) Cross-sectional area (sq.mm)			
	e) Current density (A/ mm ²)			
	f) Conductor material.			
	g) Class of Insulation.'			
	h) Power frequency withstand Level (KV-rms).			
25.4	<u>Literature</u>			
	Type Test reports as per IEC 186.			
	OGA drawing of CVT and terminal connector.			
	Characteristic curves.			
	Drawing showing clearance from earthed object.			
26	Details of Surge Arrester, connected at secondary winding of CVT.			
27	High frequency capacitance for entire carrier frequency range			
28	Equivalent series resistance over the entire frequency.			
29	Stray capacitance and stray conductance of the LV terminal over entire carrier frequency range.			
30	Capacitance (PF) /Tan delta between:- a) HV-HF point b) HF point-Ground point of International Transformer. c) HV-Ground point of Intermediate Transformer winding.			

31	Capacitive reactance of the two parts of the divider i.e. High voltage capacitor, and Intermediate voltage capacitor, connected in parallel.			
32	Total Capacitive reactance, offered by CVT			
33	Voltage ratio of the capacitor divider			
34	Open circuit Intermediate voltage			
35	Rated open circuit Intermediate voltage			
36	Reference range of temperatures within which the CVT complies with the relevant accuracy requirements			
37	Protective device, in-corporate in the CVT for limiting over voltages and/or to prevent sustained Ferro resonance.			
38	Rated voltage of Surge Arrester, connected at the secondary of CVT.			
39	Natural frequency of coupling (KHZ).			
40	Self tuning frequency of CVT (KHZ)			
41	Bandwidth (KHZ).			
42	Percentage voltage ratio (error)/phase displacement (min.)at 100% rated burden at 0.8PF lagging for measuring winding. (a) 80% of rated voltage at frequency:- (b) 120% of rated voltage at frequency:- (c) Accuracy of standard PT to be used. during determination of errors (0.05 or better.			
43	Percentage Voltage ratio /phase displacement (min.)at 25% rated burden at 0.8PF lagging for measuring winding. (a) 80% of rated voltage at rated frequency:- (b) 120% of rated voltage at rated frequency:-			
44	Percentage voltage (ratio)error /phase displacement (min.) at 100% rated burden at 0.8PF lagging for protection winding (a)5% of rated voltage. (b)1.2 times rated voltage (c)1.5 times rated voltage (d) 2% of rated voltage..			
45	Percentage voltage (ratio) error /phase displacement (min) at 25% of rated burden at 0.8PF lagging for protection winding (a)5% of rated voltage (b)1.2 times rated voltage. (c)1.5 times rated voltage. (d) 2% of rated voltage.			
46	Whether CVT is suitable for horizontal			

	transportation.			
47	Quantity of oil per CVT (Ltrs/kg)			
48	Standard to which oil conforms.			
49	Characteristic of oil(Prior to filling)			
49.1.	Breakdown voltage (kv-rms)			
49.2.	Dielectric dissipation constant tan delta)			
49.3	Water content(PPM)			
49.4	Gas content(PPM)			
49.5	Interfacial tension at 27 degree C(N/m)			
49.6	Specific resistance.			
	a) At 90 deg.C(ohm-cm)			
	b) 27 deg.C(ohm-cm)			
50	Whether CVTS are hermetically sealed? If so how?			
51	Total Weight (kg)			
52	Transport weight (kg)			
53	Dimensional details.			
54	TANK AND SECONDARY TERMINAL BOX.			
54.1	Material of the CVT tank			
54.2	Material of the secondary terminal box.			
54.3	Thickness of the CVT tank material.			
54.4	Thickness of the secondary terminal box material.			
54.5	Weather proof rating of secondary terminal box.			
54.6	Weight of tank fitting and other accessories.			
55	TERMINAL CONNECTORS			
55.1	Manufacturer's name			
55.2	Applicable standards.			
55.3	Type.			
55.4	Material of connector. (a)Clamp body. (b)Bolts and Nuts. (c) Spring Washers			
55.5	Rated current.			
55.6	(a) Rated terminal load(kg) (b) Factor of safety.			
55.7	Minimum thickness of any part(mm)			
55.8	Weight of connector complete with hardware.			
55.9	Type test reports as per IS enclosed.			
55.10	OGA drawing enclosed.			
56	BUSHING/SUPPORT INSULATOR			
56.1	Manufacturer's name			
56.2	Type.			
56.3	Applicable standards.			

56.4	Dimensions: (i)Height(mm) (ii)Diameter(top)(mm) (iii)Diameter(bottom)(mm)			
56.5	Total creepage distance (mm).			
56.6	Rated voltage(KV)(rms)			
56.7	Power frequency withstand voltage for (1 minute dry and wet(KV/rms)			
56.8	1.2/50 micro-second Impulse withstand voltage (KVP)			
56.9	Corona Extinction voltage(kv)			
56.10	Weight(kg)			
56.11	Maximum allowable span (mm)			
56.12	Cantilever strength(kg)			
56.13	OGA drawing enclosed.			

Signature of the Bidder/EPC with Seal & Date

ANNEXURE –B

CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/METERS

Sl no	CALIBRATION OF EQUIPMENTS	Furnished or not
1	Name of the Test.	
2	Meters and equipment required for the corresponding test with range accuracy make and Sl. No.	
3	Date of Calibration.	
4	Due date of Calibration.	
5	Name of the Calibrating Agency	
6	Whether Calibrating Agency is Govt. Approved.	
7	Whether documents relating to Govt. Approval of the calibrating Agency furnished?	
8	Whether the meters/ equipment fulfill the accuracy class as per calibration report	
9	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment. If yes, state the limitations.	
10	Whether green sticker or blue sticker or yellow sticker has been affixed on the body of the particular equipment/meter. State the colour of the affixed sticker.	
11	In spite of imposed limitations, whether the particular meter/ equipment can still be used? Justify its use for corresponding test(s).	
12	Remarks if any.	

Signature of the Bidder/EPC with seal and date

ANNEXURE-C
CHECK LIST TOWARDS TYPE TEST REPORTS

SL no	<u>TYPE TEST REPORTS</u>	Furnished or not
1	Name of the Type Test.	
2	Date of Test.	
3	Name of the Laboratory where the Test has been conducted.	
4	Whether the Laboratory is Government Approved.	
5	Test reports are valid as per T.S.	
6	Whether the copy of Test Report in complete shape along with drawings etc. furnished or not?	
7	Whether the Type Tested capacitive Voltage Transformer fulfills the technical requirements as per TS.	
8	If the type tested Surge Arrester does not fulfill the technical requirements as per this specification, whether the Bidder/EPC agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period.	
9	Remarks if any.	

Signature of the Bidder/EPC with seal and date

E&Q, OPTCL
